

Space Science Seminar
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**High-Energy Radiation from Thunderstorms
and Lightning: A Multi-Wavelength Approach**

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Host: Dr. Michael Briggs and Dr. Michelle Hui (sponsored by ZP12)

Thunderstorms are now recognized as the most energetic natural particle accelerators on Earth, capable of accelerating electrons and positrons, and of producing neutrons and gamma-rays up to energies of several tens of MeV. Terrestrial Gamma-ray Flashes (TGFs) are the most violent manifestation of this acceleration, delivering sub-millisecond bursts of gamma-rays that can be detected from space hundreds of kilometers far away from the production region, although other, even less studied processes at longer time scales are also at play. Although a basic mechanism for energetic electron production within thunderstorms is widely accepted, many points are still unclear, including the exact process of TGF production, their relation to lightning, and the overall pervasivity of the phenomenon. Particularly, the assessment of the number of TGFs is of fundamental importance to evaluate the overall energy budget delivered by thunderstorms in the high-energy radiation channel. This is necessary to understand any potential impact of these phenomena on atmospheric chemistry and dynamics.

It is now clear that gamma-ray observations alone are not sufficient for a complete understanding of these processes. In recent years, the greatest advances in the field have been obtained by coupling gamma-ray with radio, optical, and radar observations, in a multi-wavelength and multi-disciplinary approach that brings together astrophysicists, radio scientists, atmospheric scientists, and meteorologists. In addition, the three currently operating TGF observing satellites, Fermi, RHESSI, and AGILE, each with its own strengths and weaknesses, provide complementary views of the phenomenon. Moreover, in addition to space observations, aircraft, balloon, and ground-based observing campaigns can provide additional clues and information. I will review the recent evolution of this research field from this multi-wavelength perspective, with special focus on the recent results by the AGILE mission, and give an outlook on the opportunities for the development of this field in the near future.

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